VAN-DEN TRUONG (D3099-1)

Taking Purées to a New Level

A brownie with about "half-the-usual" calories is making taste-testers purr. The secret ingredient: butternut squash, which has a naturally high sugar content and velvety texture. When added to chocolate, butternut squash purée is a nearly unidentifiable ingredient called a "replacer," which helps the confection compete with high-fat counterparts taste-wise.

"You can cut back on sugar, fat, and oils—which are more expensive and less nutritious—when you use naturally sweet vegetable purée," says Bill Heafy, "and you get a better nutrition label."

Heafy is operations sales manager at Yamco LLC, based in Snowhill, North Carolina. In 2007, Yamco licensed a unique process for making and packaging nutritious sweetpotato purée that needs no refrigeration while sealed. The process, which provides purée that is used in a variety of finished food products, was jointly patented by collaborators with the Agricultural Research Service on behalf of the U.S. Department of Agriculture, North Carolina State University (NC State) in Raleigh, and Industrial Microwave Systems, LLC, in Morrisville, North Carolina. Team members were awarded the Food Technology Industrial Achievement Award by the Institute of Food Technologists based in Chicago, Illinois, and a Technology Transfer Award by USDA-ARS.

ARS food scientist Van-Den Truong, with the Raleigh-based Food Science Research Unit, and collaborators tested the product extensively at an NC State pilot plant. Truong's collaborators include NC State food engineers Josip Simunovic, Gary Cartwright, K.P. Sandeep, and Ken Swartzel, and former graduate students Pablo Coronel, Prabhat Kumar, and Laurie Steed. The purée exhibits ideal nutrient and color retention with little flavor loss and is shelf-stable at room temperature prior to opening.

Responding to Market Demand

In 2009, Yamco began using the unique purée-making process to make pumpkin and butternut squash purée as well. "As a functional food, these purées are stellar because they can be used as a replacer, extender, and an ingredient," says Heafy. The purées are found in bakery goods, such as cookies and pies, soups, baby foods, nutraceuticals, and beverages, including beer. About 20 to 30 percent of Yamco's sweetpotato, pumpkin, and butternut squash purées, for example, are now sold to breweries.

In 2013, Yamco further amped up versatility for commercial buyers by offering 40-ounce (2.5-pound) and 60-ounce (3.75-pound) packages. Thanks to these new packaging options, the patented purée technology can now be used to process different vegetables for a wider range of customers.

"The capability to use the technology to make different kinds of vegetable purées has always been there," says Truong. "The success of the sweetpotato purée has driven market demand, and Yamco is responding to those demands."

Yamco is now making broccoli, carrot, and spinach purées, which can be used in entrees, soups, sides, and desserts. "We are selling these purées to schools and other foodservice operations, as well as restaurants, bakeries, baby-food companies, and more," says Bobby Ham, president of Yamco.

Another advancement is that the purée technology has gone international, with patents issued in Australia, Canada, China, and New Zealand in the past few years. In addition, the U.S. Agency for International Development—which works

ARS and North Carolina State University studied several varieties of purple-fleshed sweetpotatoes (left) and discovered that they have phytochemical nutrients, called anthocyanins, in amounts comparable to those found in grapes, plums, sweet cherries, eggplant, and red radishes.

to distribute commodity staples to people at risk of malnutrition in 100 developing countries—approved a proposal to use shelf-stable purée. "We are working with consultants to meet the special nutritional, packaging, and shipping requirement of the emergency feeding programs," says Ham.

Purple-Fleshed Sweetpotatoes Show Promise

Sweetpotato cultivars with deep-purple flesh have been developed to meet a growing demand among health food markets. Genotypes for the original purple-fleshed sweetpotatoes were developed by NC State breeders Craig Yencho and Ken Pecota, who are also ARS cooperators. In addition to basic nutrients, there are bioactive phytochemicals—specifically anthocyanins—in these cultivars that give the flesh its purple color. The role of these plant chemicals in terms of human health has been investigated, and a body of evidence suggests that they could be nutritionally beneficial.

Truong and colleagues have converted purple-fleshed sweetpotatoes into frozen and shelf-stable purées for food applications. Now, Truong has made improvements to the method for extracting anthocyanins from these richly colored varieties, and he has used the method to measure the levels of anthocyanins in various purple-fleshed sweetpotato genotypes.

Using pressurized liquid extraction, the team showed that the anthocyanin content of the purple-fleshed sweetpotatoes they studied was comparable to that found in commodities such as grapes, plums, sweet cherries, eggplant, and red radishes.

"The results showed us that many of these genotypes fall in the middle of the spectrum of relatively high-anthocynanin-content fruits and vegetables," says Truong. "The amount of anthocyanin levels in purple-fleshed sweetpotatoes can potentially be increased through breeding and selection of specific genotypes."

The study was published in the *Journal of Food Composition and Analysis* in 2012.

Truong and colleagues also measured phytochemical retention before and after processing purple-fleshed sweetpotatoes into purée. "Overall, we found good phytochemical retention among the purées that were made using the patented microwave processing method and the shelf-stable packaging systems," says Truong. "These purées can be used in beverages, soups, baby foods, bakery products, frozen foods, and ice cream." The studies were published in the *Journal of Food Science* in 2008.

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ARS, North Carolina State University, and Industrial Microwave Systems LLC developed a process to make and package sweetpotato purées using a continuous-flow microwave technology. Yamco, an industry collaborator, commercialized the process.

Truong and colleagues have also conducted a study to evaluate the effect of steam cooking on anthocyanin pigments. Previously, Truong had identified cyanidin and peonidin as the major anthocyanins in extracts from purple-fleshed sweetpotatoes. The researchers have now analyzed raw and steamed samples from three different purple-fleshed sweetpotato varieties. They identified 17 anthocyanins and found that steam cooking had no significant effect on total anthocyanin content. Cyanidin and peonidin, which contribute to the blue and red hues of the purple sweetpotatoes, were easily measured by breaking down the anthocyanin extracts and using an analytical technique called "high performance liquid chromatography." This study was published in the *Journal of Agricultural and Food Chemistry* in 2010.

Sweetpotato genotypes with varying flesh color from the North Carolina State University Sweetpotato Breeding Program. ARS and the university are cooperators in the development of sweetpotato purées from various genotypes.

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These studies show that purple-fleshed sweetpotatoes hold potential for processing into high-anthocyanin purée that can be used in a variety of foods.—By **Rosalie Marion Bliss,** ARS.

This research is part of Quality and Utilization of Agricultural Products, an ARS national program (#306) described at www.nps.ars.usda.gov.

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